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Rothamsted Experimental Station, Harpenden, Herts.

Studies in Leaf Litter Breakdown
I. Breakdown Rates of Leaves of Different Species

By G. W. Heath, Margaret K. Arnold and C. A. Edwards

With 8 figures in the text

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Synopsis

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Discs were cut from leaves of eleven different plant species, chosen to range from soft and attractive, to tough and unattractive to soil animals as food. For each species, four replicates of fifty discs, 2.5 cm in diameter, were placed in nylon bags 10 × 7 cm (mesh sizes 0.003, 0.5 and 7.0 mm) and buried 2.5 cm deep in woodland or fallow soil. In one experiment leaf discs of all eleven species were used; discs of only five of the original species were used in a second to compare their rates of breakdown in the same two sites. Kale, beet, lettuce and beans disappeared within two months, probably because microbes can decompose their soft tissues rapidly. Oak only completely disappeared in 14 month when 10 % of the beech discs still remained. Elm, ash, birch, lime and maize disappeared at intermediate rates, which were slightly accelerated by allowing earthworms to feed on them.

The importance of soil animals, particularly earthworms (Lumbricids), in the breakdown of leaf material can be assessed by comparing the rate of disappearance from small and large mesh bags. Thus, when leaves go at similar rates in both, animals are unimportant, and when the rates are dissimilar, animals are important.

Scheiben von Blättern elf verschiedener Pflanzenarten wurden ausgestanzt, die nach ihrer Eignung als Futter für Bodentiere in der Reihenfolge von zarten attraktiven zu groben, unattraktiven Blattarten ausgewählt wurden. Von jeder Art wurden 4 Wiederholungen von je 50 Blattscheiben (∅ 2,5 cm) in Nylon-Gazebeuteln von 10 × 7 cm Größe (und einer Maschenweite von 0,003, 0,5 und 7,0 mm) gelegt und 2,5 cm tief in den Boden von Wald oder Brachland eingegraben. In einem Experiment wurden Blattscheiben von allen elf Arten und in einem zweiten Experiment Blattscheiben von nur fünf dieser Arten verwendet, um ihre Abbauraten an denselben Standorten zu vergleichen. Kohl-, Rüben-, Salat- und Bohnenblätter waren in zwei Monaten völlig geschwunden, wahrscheinlich weil Mikroben ihre zarten Gewebe schnell zersetzen können. Eichenblätter waren erst nach 14 Monaten vollständig verrottet, während von Buchenblättern nur noch 10 Prozent der Ausgangssubstanz verblieben waren. Ulme, Esche, Birke, Linde und Mais zeigten einen mittelmäßigen Rotteschwund, der etwas beschleunigt wurde, wenn es Regenwürmern ermöglicht war, von der Substanz zu zehren.

Die Bedeutung von Bodentieren, insbesondere von Regenwürmern (Lumbriciden), für den Abbau von Blattmaterial kann durch Vergleich der Schwundrate in eng- bzw. weitmaschigen Behältern abgeschätzt werden. Folglich sind die Tiere ohne Bedeutung, wenn die Schwundraten in beiden Varianten gleich sind und sie sind wichtig, wenn die Schwundraten unterschiedlich sind.

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1. Introduction

The importance of soil animals in transforming plant remains into humus is being increasingly recognised (KEVAN 1962). Because soil animals prefer the litter of some plant species to others, their influence in these processes is selective. DARWIN (1883) observed that earthworms preferred cherry leaves to those of lime or hazel and leaf litter of different species has long been known to decompose at different speeds. MELIN (1930) who measured decomposition of the leaves of sixteen different species from the Co_2 production of micro-organisms, found that rate of decomposition was correlated with total N content of the leaves.

Experiments to measure decomposition have been of two kinds. One determined the rate by measuring loss in dry weight of the litter in the field (FALCONER 1933, WITTICH 1939, BOCOCK and GILBERT 1957 and VAN DER DRIFT 1961). The other tested the food preference of soil animals, usually earthworms or diplopods, in the laboratory (LYFORD 1943 and FRANZ and LEITENBERGER 1958).

We have measured the amount of leaf material eaten by the total soil fauna under natural conditions, by visually assessing the amount of leaf tissue eaten.

2. Methods and Experiments

2.0. General Remarks

Two experiments are described, using techniques similar to those described by HEATH, EDWARDS and ARNOLD (1964). The mesh sizes of the nylon bags used were: —

a) 0.003 mm — to exclude all soil animals
b) 0.5 mm — to admit small soil animals and exclude earthworms ("small")
c) 7 mm — to admit all soil animals including earthworms ("large")

Each experiment was made on two sites at Rothamsted Experimental Station, one an oak-dominant woodland, the other ploughed pasture kept fallow since 1961.

2.1. Experiment I

Discs were cut from leaves of eleven different plant species[1]), chosen to range from soft and attractive, to tough and unattractive to soil animals as food. In both woodland and fallow sites, beech, oak, elm, birch and lime leaves were used as tough tissues and lettuce as a very soft one. Maize was used as monocotyledenous tissue; presumably it somewhat resembles the grass that had been incorporated into the fallow soil by cultivation. In the woodland, ash leaves were also used as typical of that site. In the fallow soil, bean, kale and beet were also included as types of crop plant that might be ploughed into an arable soil. For each species, four replicates of fifty discs, 2.5 cm in diameter, were placed in nylon bags 10 × 7 cm (mesh sizes 0.5 mm and 7.0 mm), which were buried 2.5 cm deep in soil. The amount of tissue that had disappeared was measured at various intervals, not less than seven weeks apart. The tougher tissues were slow to disappear and the experiment continued for more than a year. Because the soft tissues disappeared almost completely in the seven weeks before the first inspection, a second experiment was started twelve months later; in this the leaf tissue was examined once a week for the first five weeks, and then at increasingly longer intervals.

2.2. Experiment II

Five of the original eleven species, ash, elm, beet, maize and lettuce were buried in the same two sites. Two sets of bags were put into the woodland site, one buried in the soil and the other laid on the soil surface beneath the litter layer. To avoid excessive damage by frequent handling, for each species eight replicates of twenty-five 2.5 cm diameter discs were placed in a single layer in nylon bags 14 cm square (mesh size 0.5 mm only) (fig. 1), as already briefly described by HEATH et al. (1964). These bags were made like a sandwich, and the discs were laid on one half

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[1]) The species used were: oak — *Quercus robur* L.; beech — *Fagus sylvatica* L.; elm — *Ulmus campestris* L.; birch — *Betula alba* L.; lime — *Tilia europaea* L.; ash — *Fraxinus excelsior* L.; bean — *Vicia faba* L.; kale — cultivated variety of *Brassica oleracea* L.; beet — cultivated variety of *Beta vulgaris* L. (ssp. *vulgaris*); maize — variety of *Zea Mays* L.; lettuce — cultivated variety of *Lactuca sativa* L. (All according to CLAPHAM, TUTIN and WARBURG 1952).

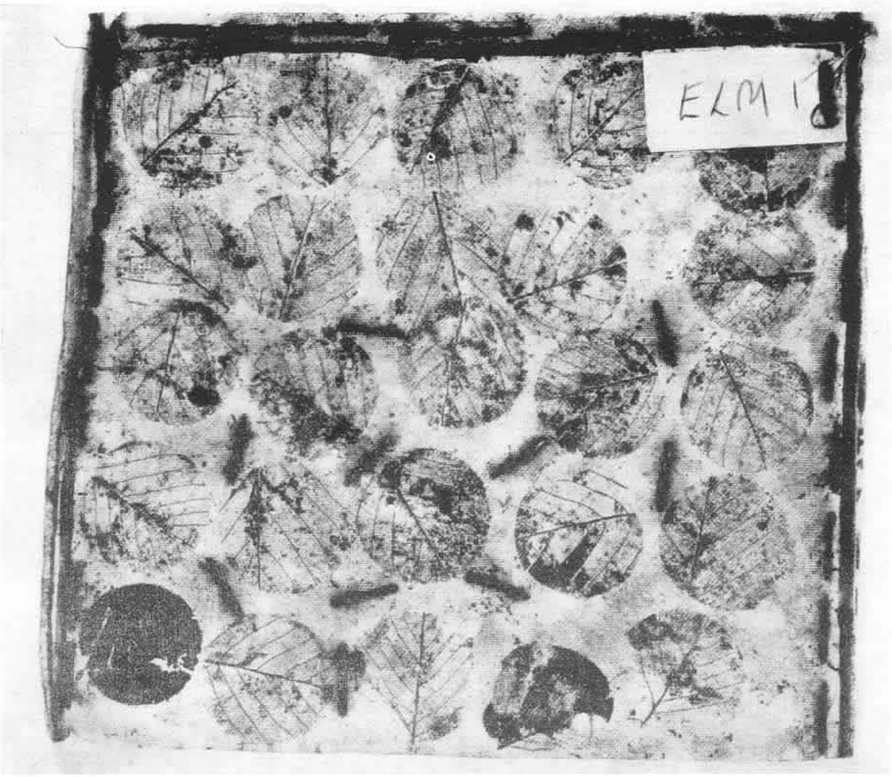

Fig. 1. Leaf discs in small mesh 0.5 mm bag, appearance towards the end of 2nd experiment.

of a rectangle of mesh, which was folded over and the three open sides stapled together. Staples were also inserted between the discs to prevent them slipping and overlapping, so that the discs could be examined undisturbed through the mesh. Sometimes it was necessary to brush or wash soil carefully off the bags before examining the discs. When discs were not removed from bags the amount of material that had disappeared was estimated only visually because the mesh prevented photometric estimation.

At the beginning of both experiments some leaf material from each plant species was buried in bags of 0.003 mm mesh, which excluded all soil animals; these were examined periodically to assess decomposition. At the end of the second experiment the remains of discs of ash, elm, beet and maize in these bags were oven dried and their ash-free weight determined.

In May and August 1963 sixteen litter samples 12 cm in diameter were taken from the woodland site; in June and August sixteen 5 × 15 cm soil cores were taken from the fallow site. Sixteen similar soil cores were again taken from the fallow site in October 1964; in December 1964 sixteen litter samples 15 cm in diameter were collected from the woodland site. Animals were extracted from all samples for three days in Tullgren funnels and collected in 75% alcohol (with 5% glycerol) and later sorted into taxonomic groups. Earthworm populations in the two sites had been estimated previously by Edwards and Heath (1963).

3. Results

The percentages of leaf area that disappeared are shown in the graphs and the results, together with the 95% confidence limits, are given in Tables 1 and 2 for the first experiment and 3, 4 and 5 for the second experiment.

Figures 2 and 3 show results from the fallow land. When buried in small mesh (0.5 mm) bags, the different species fall into three groups according to the rates their leaves dis-

Table 1 First Expt. Percentage Disappearance with 95 % Confidence Limits.

Site: Fallow soil

Mesh size:	**Small**				**Large**			
Sample date:	30/10	12/3	9/5	9/11	30/10	12/3	9/5	9/11
Beech	0.02 *1.09* 3.76	0.02 *1.93* 5.21	1.53 *4.32* 8.50	14.21 *22.18* 31.29	0.00 *2.18* 10.65	0.00 *5.44* 24.62	13.97 *39.43* 68.49	*90.00*
Oak	0.70 *3.02* 6.96	2.50 *6.52* 11.14	7.37 *12.03* 13.14	23.62 *33.22* 43.30	5.49 *16.67* 32.33	14.96 *39.60* 67.51	72.93 *93.81* 100.00	—
Elm	78.82 *85.72* 91.45	82.16 *88.52* 93.66	88.47 *93.38* 97.01	—	95.09 *99.84* 100.00	—	—	—
Birch	18.81 *26.37* 34.74	32.57 *41.31* 50.38	59.20 *67.59* 75.34	79.32 *87.03* 93.17	18.53 *34.55* 52.70	78.57 *96.15* 100.00	—	—
Lime	19.63 *27.30* 35.74	29.98 *38.58* 45.87	50.54 *59.19* 67.50	73.24 *81.87* 88.13	36.29 *54.53* 72.15	69.13 *90.95* 99.95	90.91 *99.99* 100.00	—
Bean	98.83 *99.97* 100.00	—	—	—	—	—	—	—
Kale	93.56 *97.27* 99.44	—	—	—	94.59 *99.74* 100.00	—	—	—
Beet	93.99 *97.49* 99.54	—	—	—	—	—	—	—
Maize	*46.16*	64.12 *72.54* 80.25	83.26 *89.18* 93.94	95.64 *98.87* 99.99	72.47 *87.04* 96.65	95.28 *98.63* 100.00	90.06 *99.94* 100.00	—
Lettuce	*100.00*	—	—	—	95.28 *99.88* 100.00	—	—	—

Note: Figures in italics are mean values, the figure above is the lower 95 % confidence limit, the figure below is the higher 95 % confidence limit.

appeared (fig. 2). Kale, beet, lettuce and beans disappeared very quickly; lettuce and beans were completely gone and only small amounts of kale and beet remained at the first inspection after seven weeks. Beech and oak disappeared very slowly, only about 13 % and 23% respectively during fourteen months. The other species are intermediate, 100 % of elm and 75 % of lime disappearing in fourteen months.

When the leaf tissues were put into large mesh (7 mm) bags, which allow earthworms to feed, beech and oak disappeared much faster (fig. 3), and 90 % of beech and 100% of oak was gone in fourteen months. Kale, beet, lettuce and beans were all completely gone from the large mesh bags by the first inspection after seven weeks. Of the intermediate group, elm had also completely disappeared by the first inspection and leaves of the other species had been affected more than in small mesh bags.

In the woodland site the leaves of different species disappeared at three different rates, as in the fallow soil (figs. 4 and 5). Allowing earthworms to feed on the discs in woodland soil accelerated birch, lime, elm, oak and beech disappearance but less so than in fallow soil (cf. figs. 4 and 5 with figs. 2 and 3).

Figures 6, 7 and 8, which show results from the second experiment are for small mesh bags only. The results resemble those in Experiment I, but the more frequent inspections

Table 2 First Expt. Percentage Disappearance with 95 % Confidence Limits.

Site: Woodland soil								
Mesh size:	**Small**				**Large**			
Sample date:	30/10	12/3	9/5	9/11	30/10	12/3	9/5	9/11
	0.00	1.34	4.98	12.90	0.00	0.42	8.46	44.59
Beech	*0.67*	*5.29*	*11.36*	*20.46*	*0.48*	*12.03*	*24.54*	*64.28*
	3.87	11.64	19.91	29.18	4.18	35.80	45.12	81.46
	0.04	1,68	3.64	16.22	0.00	0.00	18.39	74.69
Oak	*1.84*	*5.93*	*9.34*	*24.39*	*1.98*	*15.90*	*37.90*	*89.40*
	6.20	12.55	17.32	33.56	7.50	28.70	59.36	97.60
	28.17	80.16	87.62	91.00	76.64	85.10	89.72	
Elm	*39.09*	*88.52*	*94.30*	*95.95*	*87.03*	*98.87*	*98.75*	—
	50.60	94.82	98.51	98.98	94.71	100.00	100.00	
	0,02	38.67	67.59	66.19	0.19	64.90	92.77	
Birch	*1.70*	*50.17*	*78.10*	*75.45*	*3.19*	*88.63*	*99.72*	—
	5.98	61.67	87.04	83.58	9.65	99.90	100.00	
	0.28	39.79	57.65	71.21	0.67	26.20	76.93	94.78
Lime	*2.84*	*51.39*	*69.05*	*79.95*	*4.68*	*54.18*	*92.30*	*99.87*
	7.92	62.86	79.39	87.39	12.04	80.60	99.60	100.00
	0.00	21.97	51.74	80.71	0.00	32.40	81.46	
Ash	*0.51*	*32.24*	*63.44*	*88.07*	*0.95*	*61.07*	*95.09*	—
	3.48	43.47	74.34	93.81	5.37	85.00	100.0	
	24.17	62.69		90.91	43.04	75.40	89.72	
Maize	*34.72*	*73.47*	*92.40*	*95.88*	*56.61*	*94.86*	*98.87*	—
	46.09	82.99		98.94	69.69	100.00	100.00	

See note on Table 1.

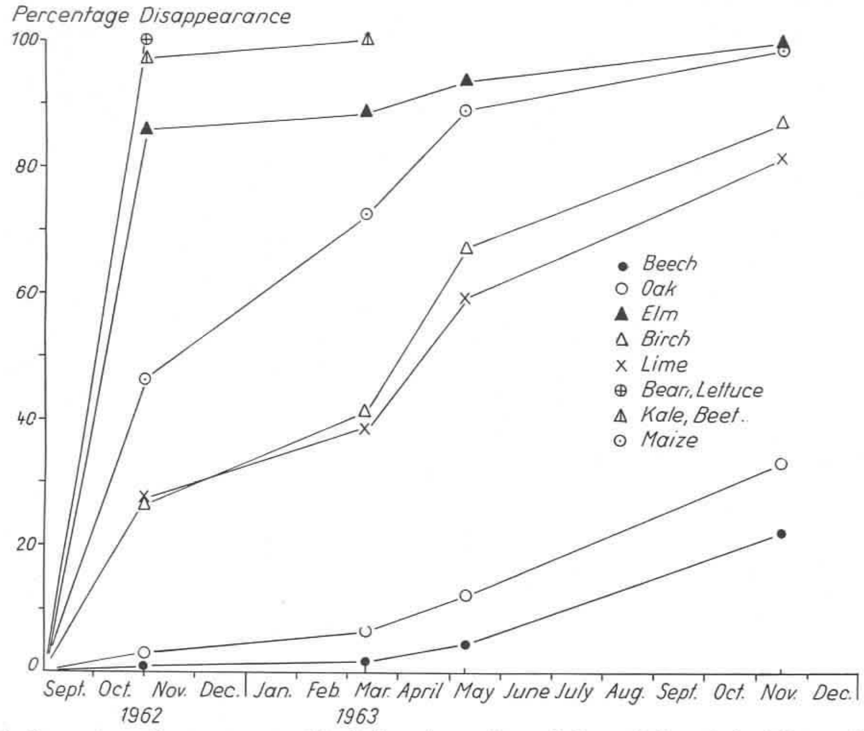

Fig. 2. Percentage disappearance of leaf discs in small mesh bags (0.5 mm) in fallow soil (1st experiment).

Table 3 Second Expt. Percentage Disappearance with 95 % Confidence Limits.

Site: Fallow soil
Mesh size: **Small**

Sample	19/9	26/9	3/10	10/10	17/10	1/11	14/11	13/12	22/1	17/4	25/6	14/9
Ash	0.00	0.00	0.00	0.04	0.37	1.93	3.03	15.14	11.9	31.10	50.52	89.40
	0.01	*0.22*	*0.19*	*0.35*	*0.95*	*3.07*	*3.84*	*22.76*	*25.60*	*38.75*	*58.68*	*92.95*
	0.03	0.98	1.02	0.91	1.79	4.68	6.10	31.43	26.68	48.60	66.60	95.74
Elm	0.19	3.6	5.68	8.74	8.74	12.63	9.65	20.04	24.84	38.92	56.42	87.73
	0.35	*5.77*	*8.64*	*11.03*	*10.92*	*15.01*	*13.08*	*28.39*	*33.39*	*48.77*	*64.45*	*91.55*
	0.56	8.35	12.10	13.43	13.31	18.20	16.93	37.39	42.35	58.85	72.07	94.76
Beet	0.48	25.0	38.24	48.42	52.79	60.73	64.11	71.76	79.95	84.35	92.85	97.91
	0.72	*29.50*	*43.90*	*52.09*	*56.43*	*64.95*	*69.21*	*80.08*	*86.92*	*90.85*	*96.48*	*99.33*
	1.62	34.21	49.65	55.92	60.05	69.05	76.66	87.27	92.58	95.01	98.87	99.96
Maize	0.00	0.19	0.88	2.34	1.13	2.28	3.01	12.15	20.04	38.07	52.96	85,23
	0.01	*0.88*	*2.28*	*3.64*	*2.03*	*3.77*	*5.14*	*19.21*	*28.08*	*38.07*	*60.05*	*89.40*
	0.06	2.03	4.32	5.21	3.19	5.29	7.69	27.30	36.89	47.90	67.90	91.00
Lettuce	24.39	67.59	88.85	99.74	96.86	98.29						
	25.75	*72.23*	*92.21*	*98.01*	*98.01*	*99.27*	—	—	—	—	—	—
	27.14	76.64	95.61	98.94	98.90	99.81						

See note on Table 1.

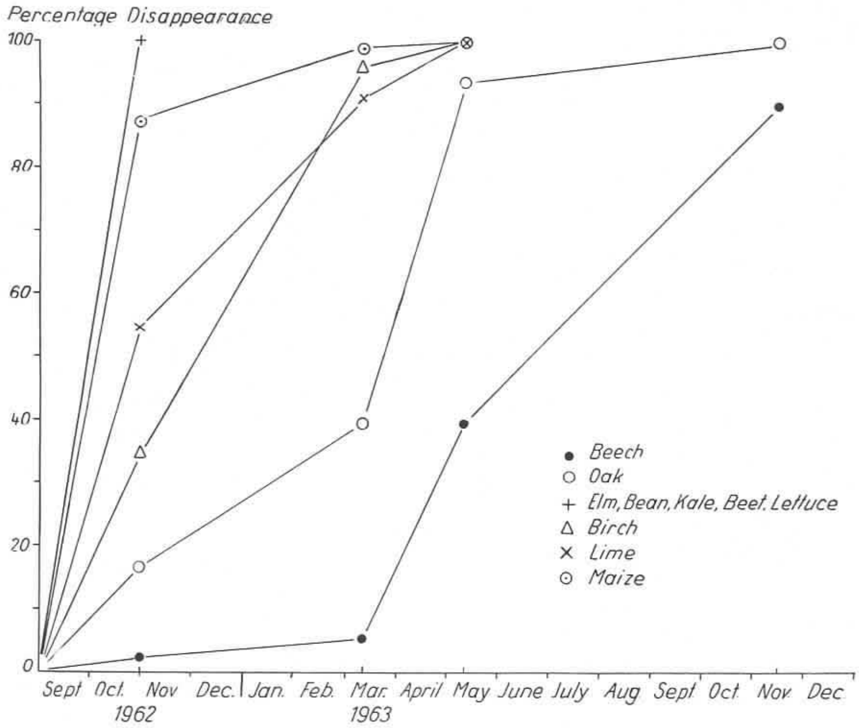

Fig. 3. Percentage disappearance of leaf discs in large mesh bags (7 mm) in fallow soil (1st experiment).

Table 4 Second Expt. Percentage Disappearance with 95 % Confidence Limits.

Site: Woodland soil
Mesh size: **Small**

Sample date:	19/9	26/9	3/10	10/10	17/10	1/11	14/11	13/12	22/1	17/4	26/6	14/9
Ash		0.00	0.00	0.46	1.20	5.29	23.06	63.44	86.08	84.48	91.05	94.30
	0.00	*0.03*	*0.09*	*1.24*	*1.44*	*7.50*	*27.46*	*67.42*	*88.74*	*88.74*	*93.21*	*94.33*
		1.74	0.79	2.44	1.74	10.06	32.08	71.28	91.15	92.40	95.01	94.93
Elm	0.50	0.00	0.20	4.32	13.07	30.78	48.77	73.16	55.83	84.85	93.21	94.47
	1.32	*0.64*	*1.05*	*6.35*	*13.79*	*35.04*	*53.83*	*76.79*	*92.02*	*89.07*	*93.21*	*94.78*
	2.50	3.77	2.50	8.65	14.52	39.43	58.85	80.22	94.06	92.67	95.01	95.09
Beet		2.55	21.0	51.91	69.21	77.96	88.74	87.84	98.75			
	0.00	*7.41*	*25.91*	*56.44*	*70.17*	*81.60*	*91.74*	*90.45*	*99.48*	—	—	—
		14.52	30.91	60.90	71.13	84.90	94.30	92.76	99.90			
Maize		0.00	0.00	0.98	4.61	4.18	14.03	29.02	36.21	53.83	70.33	85.23
	0.00	*0.08*	*0.39*	*2.08*	*5.06*	*6.18*	*17.59*	*32.89*	*40.28*	*60.05*	*73.93*	*85.72*
		2.03	1.40	3.57	5.53	8.54	37.39	36.89	44.25	66.11	77.23	86.20
Lettuce	1.74	34.71	82.13	98.46	99.87							
	3.07	*45.99*	*86.20*	*99.27*	*99.94*	—	—	—	—	—	—	—
	4.75	57.47	89.72	99.89	99.92							

See note on Table 1.

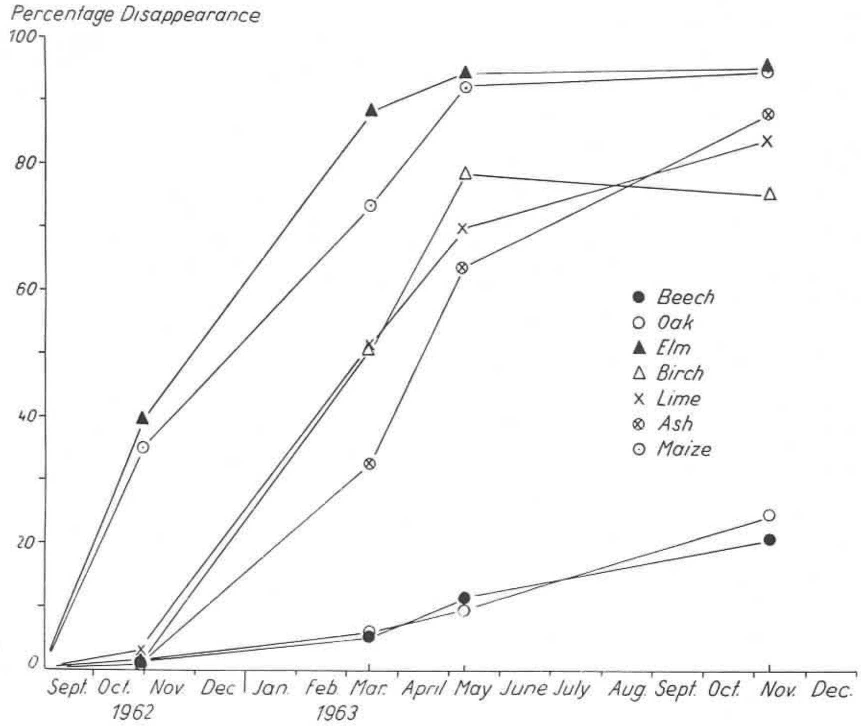

Fig. 4. Percentage disappearance of leaf discs in small mesh bags (0.5 mm) in woodland soil (1st experiment).

Table 5 Second Expt. Percentage Disappearance with 95 % Confidence Limits.

Site: Woodland litter
Mesh size: **Small**

Sample date	19/9	26/9	3/10	10/10	17/10	1/11	14/11	13/12	22/1	17/4	25/6	14/9
Ash	0.00	0.00	0.13	0.85	1.44	8.84	29.66	51.64	77.96	87.03	94.30	95.24
	0.01	*0.17*	*0.62*	*1.24*	*2.78*	*12.84*	*34.55*	*56.96*	*82.67*	*89.82*	*96.29*	*95.60*
		0.79	1.44	1.70	4.13	17.46	39.60	62.77	86.92	92.30	97.86	95.95
Elm	0.14	0.19	1.52	6.69	14.39	25.30	40.28	62.09	75.36	83.97	91.64	93.98
	0.19	*0.82*	*2.72*	*7.69*	*17.86*	*31.11*	*45.47*	*67.75*	*80.23*	*87.04*	*94.06*	*94.39*
	0.23	1.88	4.25	8.74	21.60	37.22	50.69	73.16	84.73	89.82	96.04	94.78
Beet		1.65	20.89	43.90	50.17	60.98	80.22	85.10	94.93			
	0.00	*3.07*	*24.39*	*45.82*	*54.88*	*68.08*	*84.23*	*89.07*	*97.22*	—	—	—
		4.90	28.08	47.73	59.53	73.93	87.84	92.40	98.83			
Maize	0.02	0.00	0.00	1.48	1.44	2.66	11.81	30.94	40.28	59.02	71.60	82.00
	0.03	*0.05*	*0.08*	*1.98*	*2.78*	*5.14*	*15.39*	*36.55*	*46.16*	*63.27*	*75.60*	*82.67*
	0.05	0.51	0.24	2.55	4.55	8.35	19.35	42.35	52.09	72.23	79.53	83.32
Lettuce	4.90	40.11	69.53	83.71	87.27	94.55	99.40					
	5.06	*44.77*	*73.32*	*85.11*	*90.24*	*97.10*	*99.94*	—	—	—	—	—
	5.29	49.47	76.64	86.32	92.85	98.87	100.00					

See note on Table 1.

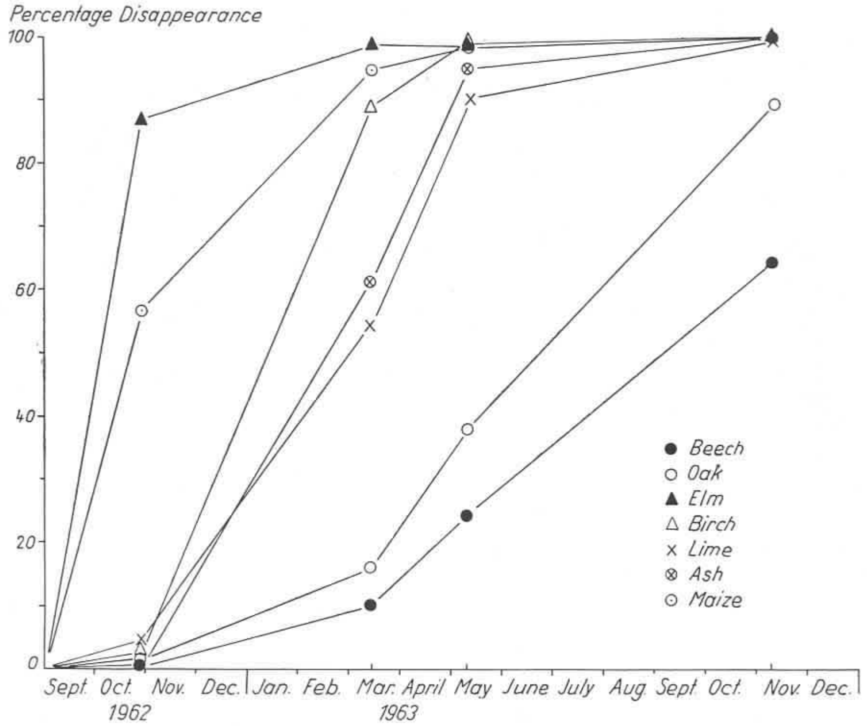

Fig. 5. Percentage disappearance of leaf discs in large mesh bags (7 mm) in woodland soil (1st experiment).

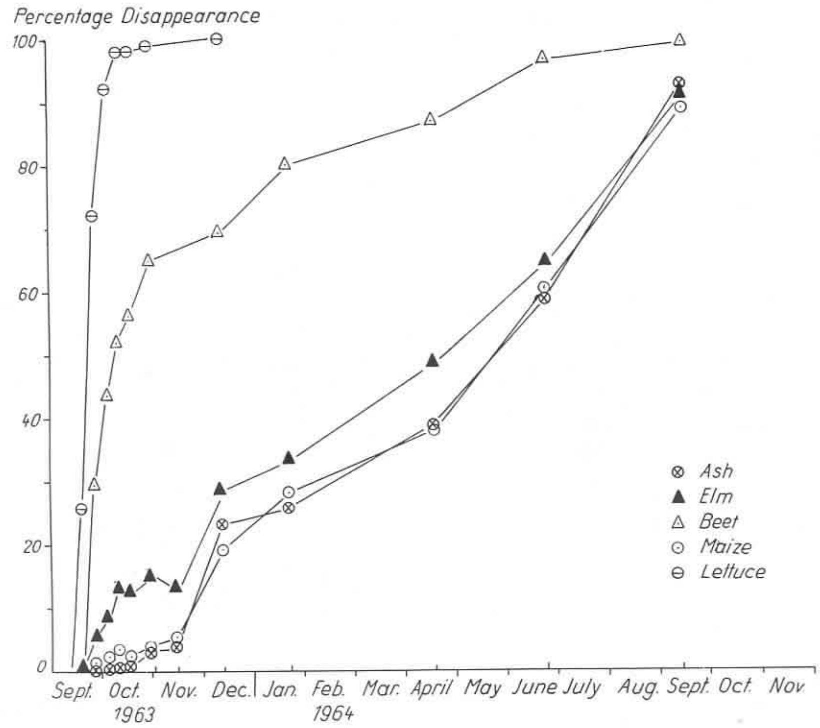

Fig. 6. Percentage disappearance of leaf discs in fallow soil (2nd experiment).

enabled the disappearance rates of lettuce and beet to be estimated and showed that beet disappeared more slowly than lettuce on the fallow site. Discs buried in the woodland soil disappeared at much the same rate as those laid on the soil surface under the litter (figs. 7 and 8). Ash and elm differ strikingly in the two sites (figs. 6 and 7), and the line for the disappearance of ash in the woodland site is almost straight. Elm disappeared more slowly from the fallow site in the second experiment (fig. 6) than in the first (fig. 2). The difference in the rate at which the leaves, particularly ash, disappeared from small mesh bags in the woodland site during the two experiments (figs. 4 and 7) probably reflects the cold winter of 1962/63; many of the lines (figs. 2, 3, 4 and 5) are flattened during the period October 1962—March 1963.

The results with maize in the first experiment are unreliable because the handling of the discs caused some tissue to disappear. This was avoided in the second experiment and the results show a steady and consistent rate of disappearance in both sites.

The fallow site was sampled for its population of animals at two-monthly intervals throughout the tests. Table 6 gives the annual means of the populations and shows that some species, particularly oribatids, become fewer as a result of fallowing. Table 7 shows the numbers of animals found on the three occasions that both fallow and woodland sites were sampled.

4. Discussion

The two experiments showed that leaves of different plant species disappeared at three different rates. Lettuce, beet, kale and bean disappeared fastest; elm, ash, birch, lime and maize disappeared quickly at first but in small mesh bags in fallow soil some

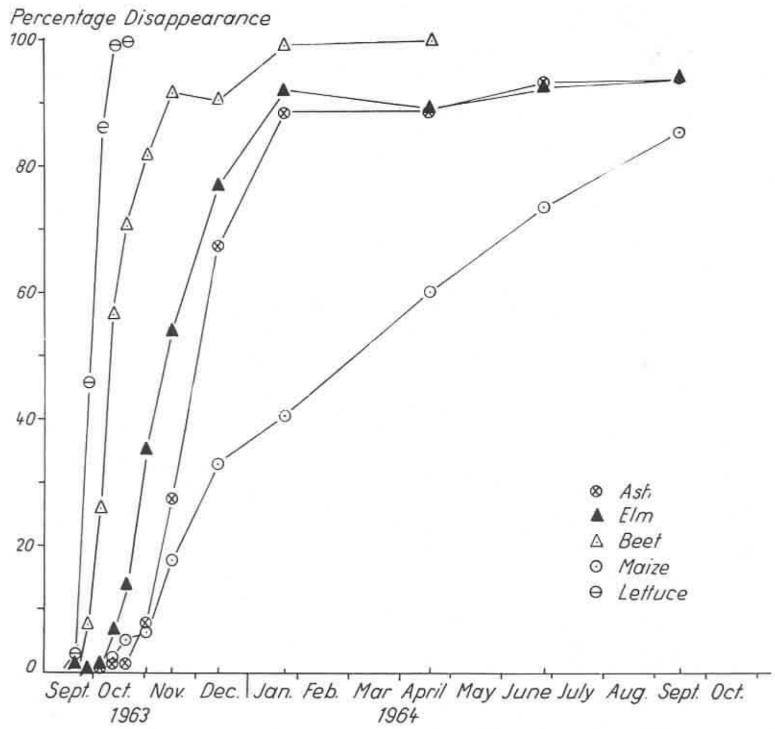

Fig. 7. Percentage disappearance of leaf discs in woodland soil (2nd experiment).

Table 6 Annual means of soil animal numbers per sq. metre in the fallow site.

	Oribatei	Onychiuridae	Isotomidae	Entomobryidae	Symphyla	Pauropoda
August 1962—July 1963	3,458	10,098	5,916	2,040	561	413
August 1963—June 1964	903	9,588	5,228	816	306	199

	Diplopoda	Diptera (larvae)	Coleoptera (larvae)	Enchytraeidae
August 1962—July 1963	51	92	179	1,173
August 1963—June 1964	122	128	138	1,428

residue remained at the end of the experiment. Oak and beech disappeared much slower than any of the others, whether in bags of small or large mesh. Lettuce, beet, kale and bean disappeared within a few weeks, at rates independent of mesh size or site and before ash or elm showed signs that animals had fed on them, which suggests that lettuce, beet kale and beans are decomposed almost exclusively by micro-organisms; this suggestion is supported by the fact that the very fine (0.003 mm) mesh bags, which excluded all soil animals and so allowed breakdown only by microbes, contained at the end of the experiments no trace of lettuce residue and that beet discs had lost 80% of their dry matter.

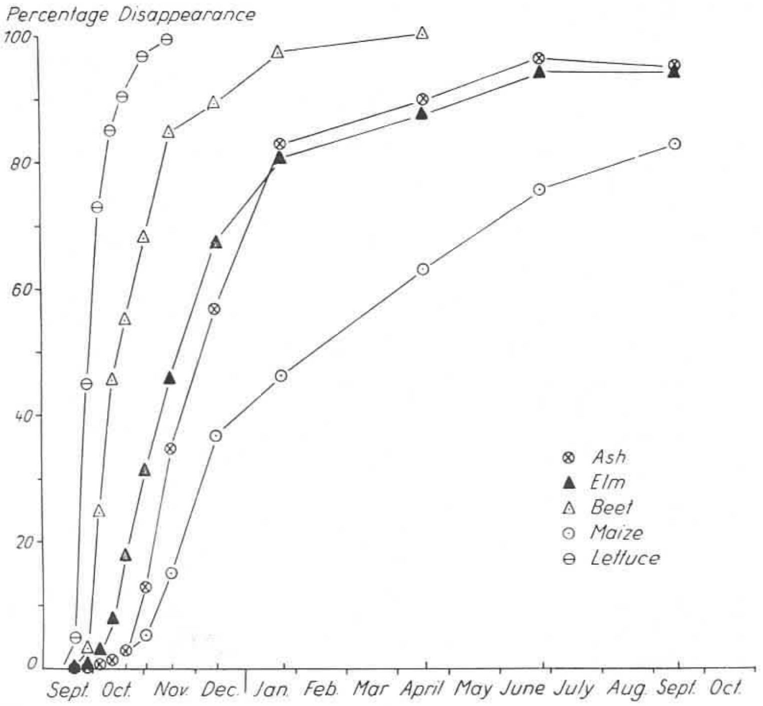

Fig. 8. Percentage disappearance of leaf discs in woodland litter (2nd experiment).

Table 7 Numbers per sq. metre of soil animals present in both sites on three sampling dates (F = fallow, W = woodland).

	Oribatei		Onychiuridae		Isotomidae		Symphyla	
	F	W	F	W	F	W	F	W
May/June 1963	1,326	11,540	3,162	93	1,836	8,898	408	9
August 1963	1,428	27,025	5,304	0	6,426	12,868	663	9
Oct./Dec. 1964	2,193	17,006	52,428	230	3,621	6,289	255	0

	Diplopoda		Diptera (larvae)		Coleoptera (larvae)		Enchytraeidae	
	F	W	F	W	F	W	F	W
May/June 1963	61	0	0	173	306	27	2,601	1,089
August 1963	204	9	61	226	31	53	1,326	425
Oct./Dec. 1964	204	0	255	957	459	312	714	242

Kurčeva (1960) found that excluding soil animals from oak litter by napthalene, so that decomposition was by micro-organisms alone, decreased weight loss during the 4½ months from April to August from 50% to 10% (see also Kurčeva 1964). In our first experiment oak discs in large mesh bags in woodland soil (fig. 5) lost about 40% of their lamina during these months. We have not yet studied the effect of excluding all animals from oak discs, but are making an experiment in pots to study the effects of micro-organisms alone and of micro-organisms plus small soil animals.

Most leaf material on these sites is eaten by earthworms (Edwards and Heath 1963) and the difference in disappearance from bags of different mesh sizes indicates the importance of soil animals in decomposing leaves. They are very important in destroying oak and beech but much less for other species. The relative importance of microbes and soil animals can be assessed by comparing the steepness of the lines in fig. 2 and fig. 3. The less the difference between the lines for a particular leaf species in the two graphs, the less the importance of animals in the breakdown of that species; conversely, the greater the difference, the greater the importance of soil animals.

Table 4 shows that fallowing generally lessened the numbers of soil animals, especially oribatids and Table 7 shows that the woodland litter contains more oribatids than the fallow soil. However, neither the decline in numbers nor the difference in population of animals seem great enough to account for the different rates of disappearance of ash and elm (cf. figs 6, 7 and 8). The difference may mean that animal species that survive in the fallow are not adapted to feed on the tree leaves or that microbial activity differs in the two sites. Certainly the habitats are very different and the difference in the lines for beet in figs. 6 and 7, may indicate different microbial activity because beet seems to be mainly decomposed by microbes.

The differences between the two sites when earthworms fed on the leaves are probably explained by the different earthworm species in the two sites (Edwards and Heath 1963). *Lumbricus rubellus* and *L. terrestris* are the dominant species in the woodland, and *L. castaneus*, *Allolobophora nocturna* and *A. caliginosa* in the fallow soil.

5. Literature

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Address of the authors: Dr. G. W. Heath, Miss Margaret K. Arnold and Dr. C. A. Edwards, Entomology Department, Rothamsted Experimental Station, Harpenden, Herts. (England).